relative deficiency or sufficiency in terms of crop growth (Table 1). Interpretation of the categories in terms of probability of crop response is explained in Table 2. In the UVM soil testing program, results are expressed as parts per million (ppm) of elemental P, K, magnesium (Mg), etc. (Note that milligram / kilogram—mg / kg—is equivalent to ppm.) For categories expressed in other units, see Table 19 in Appendix.

# Aglime

Most soils in Vermont need periodic applications of aglime to maintain pH in a range optimum for crop production. Maintaining a good pH level is important for maximizing availability of plant nutrients, for encouraging activity of beneficial soil microorganisms, and for maintaining soil conditions that will support good root growth and crop production. A pH of 6.8 is recommended for alfalfa or if alfalfa is to be seeded within two years. A pH of 6.2 is recommended for all other field crop situations.

Lime requirement is based on a combination of soil pH and reactive Al soil test. The pH tells us whether or not aglime is needed. However, different soils with the same pH may require very different amounts of aglime to reach the optimum pH. The reactive Al level is an indicator of the amount of reserve soil acidity that needs to be neutralized in order to change the pH and is used to determine the application rate of lime (Table 3). Recommendations are given in tons of aglime per acre, assuming a calcium carbonate equivalent (CCE) of 90% or higher. Most aglime sold in Vermont is within this range, but if your liming material has a CCE less than 90%, application rate should be increased accordingly. A common liming material in much of Vermont is aglime-wood ash blend (typically 80% aglime, 20% wood ash). While lime-ash has a slightly lower CCE than pure aglime, it contains some potash and other nutrients and is an excellent liming material.

**Table 1. Soil test categories.**

| | Low | Medium | Optimum | High | Excessive |
|---|---|---|---|---|---|
| | ppm | | | | |
| Available P | 0-2 | 2.1-4 | 4.1-7 | 7.1-20 | >20 |
| K | 0-50 | 51-100 | 101-130 | 131-160 | >160 |
| Mg | 0-35 | 36-50 | 51-100 | >100 | — |

Note: Soil test extractant is the Vermont Buffer, or modified Morgan's (1.25 *M* $NH_4$ acetate, pH 4.8).

**Table 2. Interpretation of soil test categories.**

| | |
|---|---|
| Low (L) | High probability of crop response to addition of nutrient. Substantial amounts of additional nutrients needed to achieve optimum yields. In the case of phosphorus, the amount of P needed will vary with the level of reactive aluminum (Al)—more P needed with high Al. |
| Medium (M) | Moderate probability of crop response to addition of nutrient. Moderate amounts of additional nutrients needed to achieve optimum yields. |
| Optimum (OPT) | Most desirable soil test range on economic and environmental basis. Low probability of crop response to addition of nutrient, but to maintain in this range for successive years, a portion of crop removal needs to be replaced. If crop planning is done on short-term basis (e.g., one-year land rental) recommended broadcast fertilizer can be eliminated with low probability of yield reduction. However, in that case soil testing should be done annually to assure that soil test does not drop below optimum level. |
| High (H) | Higher soil test than needed for optimizing yields of most crops. Very low probability of crop response to addition of nutrient. No additional nutrients needed except K for high K-demanding crops on high-yielding sites. Low rate of starter fertilizer may be needed. |
| Excessive (EX) | Soil test higher than desirable for economic and / or environmental reasons. No fertilizer recommended. Addition of nutrients may cause nutrient imbalance. |

**Table 3. Aglime requirement based on soil pH, reactive Al, and target pH.**

| Soil pH[1] | Reactive Al | Target pH | |
|---|---|---|---|
| | | 6.8 | 6.2 |
| | ppm | tons / acre | |
| >6.7 | | 0 | 0 |
| 6.2-6.7 | 0-40 | 1 | 0 |
| | >40 | 2 | 0 |
| 5.6-6.1 | 0-40 | 2 | 1 |
| | 41-70 | 2.5 | 1.5 |
| | 71-100 | 3 | 1.5 |
| | 101-150 | 3.5 | 2 |
| | 151-200 | 4 | 2.5 |
| | >200 | 5 | 3 |
| <5.6 | 0-40 | 3 | 1.5 |
| | 41-70 | 3.5 | 2 |
| | 71-100 | 4 | 2 |
| | 101-150 | 4.5 | 2.5 |
| | 151-200 | 5 | 3 |
| | 201-250 | 5.5 | 3.5 |
| | 251-300 | 6 | 4 |
| | >300 | 7 | 5 |

[1] Soil pH is reported as the equivalent of pH measured in water (approximately 0.6 higher than pH measured in 0.01 *M* $CaCl_2$).

# Nitrogen

## *Nitrogen for Annual Crops*

Most annual nonlegume crops are very responsive to application of N. Table 4 shows recommended N application rates for annual crops (without credit for manure or previous crop). If the previous crop was a perennial forage crop or other legume crop, adjust values by subtracting previous crop N credits in Table 5. If manure has been applied in the past two years, subtract manure N credits calculated from Tables 14 to 17. Nitrogen rates are adjusted based on soil drainage class. Soils with poor or excessive drainage receive higher N recommendations because of the higher potential for gaseous N loss (denitrification) or nitrate leaching and / or slower N release via mineralization. The adjustments for previous crop, applied manure, and soil drainage are attempts to make N recommendations more site-specific, but they are estimates based on average weather and soil conditions. For a more reliable recommendation for corn, sidedress N when corn is 12 to 24 inches tall at a rate based on the Presidedress Soil Nitrate Test (PSNT) from a soil sample taken when plants are 8 to 12 inches tall (Table 6).

Nitrogen rates for corn, whether based on a PSNT or on previous crop and manure, are also adjusted for yield level. This is a well-established practice based on the fact that a higher yielding crop takes up more N than a low yielding one. However, evaluation of long-term N response trials on corn in Wisconsin, Iowa, and Pennsylvania has shown poor correlation between yield level and optimum fertilizer N rate. It appears that soil and weather conditions conducive to producing high crop yields are the same conditions that support greater N supply from soils and more efficient use of that N by plants. There is evidence for some variation in optimum N rate based on soil type and climate, resulting in soil yield potential differences. Long-term average yield on a particular soil or field is a better estimate of soil yield potential and optimum N rate than yield goal, or maximum attainable yield, which commonly leads to over-fertilization.

In Vermont we are using a combination of drainage class and a more limited adjustment based on yield level than is used in some states (Table 4). The resulting N recommendation will be more accurate if it is based on a long-term average for the field, rather than a "yield goal" or maximum yield. The best approach is to use the PSNT, which will provide a recommendation based on the specific field conditions in a given year (Table 6).

Following are several application suggestions or adjustments in the recommended N rates:

- Nitrogen rates in Table 4 are total amount of N to apply, both manure and fertilizer, including starter and broadcast or sidedress N. Apply a portion of the recommended N as a starter fertilizer banded with the planter (10-30 lb / acre for corn, 10-20 lb / acre for winter small grains, 10-30 lb / acre for spring small grains). Use the higher rates where no pre-plant N or manure has been applied. Subtract starter N rate to determine application rate for broadcast or sidedressing. (For more information, see UVM Extension Br 1392, *Starter Fertilizer for Corn in Vermont*.)
- The salts in fertilizer—primarily N and K compounds—can cause poor germination and seedling injury if excessive rates are applied near the seed. To prevent these problems, limit the rate of starter fertilizer. For corn, limit combined N + $K_2O$ banded with planter (2" to the side and 2" below the seed) to 80 lb / acre.